Monthly
Performance
Report

ZEIN MECHANICAL

JUNE 1978

FEB 14 198.

U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

I. SYSTEM DESCRIPTION

The Zein Mechanical site is a single family residence located in Milwaukee, Wisconsin. The home has two separate solar energy systems: an air system for space heating and cooling; a liquid system to preheat the potable hot water. The two systems are shown schematically in Figure 1.

The space heating system, designated Zein Mechanical No. 1, is designed to supply approximately 44 percent of the space heating requirements for the 1,388 square foot residence. This system has a solar array of double-glazed acrylic collectors with a gross area of 384 square feet. The collectors, manufactured by Solaray, Inc., face south at an angle of 53 degrees from the horizontal. A fan circulates the solar heated air through the 412.5 cubic foot rock thermal storage, across the heat pump coil, then back to the inlet side of collectors. Thus, the solar heated air assists the heat pump in providing thermal energy to the heat exchanger in the air handler. Auxiliary space heating energy is supplied by 4-kw and 6-kw electric strip heaters. In the summer, the heat pump can also function in the cooling cycle to maintain desired temperatures in the conditioned space. The solar energy system components, heat pump compressor, evaporator, circulating fan, and rock thermal storage are located inside a sealed and insulated room in the house basement. Excessive heat buildup in the rock thermal storage is rejected to the ouside ambient either through back-draft damper D5, or through the collectors.

The liquid system, designated Zein Mechanical No. 2, uses distilled water as the transfer medium. This system has a solar array with a gross area of 77.6 square feet. The collectors, manufactured by Solarcraft, face south at an angle of 30 degrees from the horizontal. Solar heated water flows through the heat exchanger within the 82-gallon domestic hot water (DHW) heater to preheat the domestic hot water. Auxiliary energy for

- I001 COLLECTOR PLANE TOTAL INSOLATION
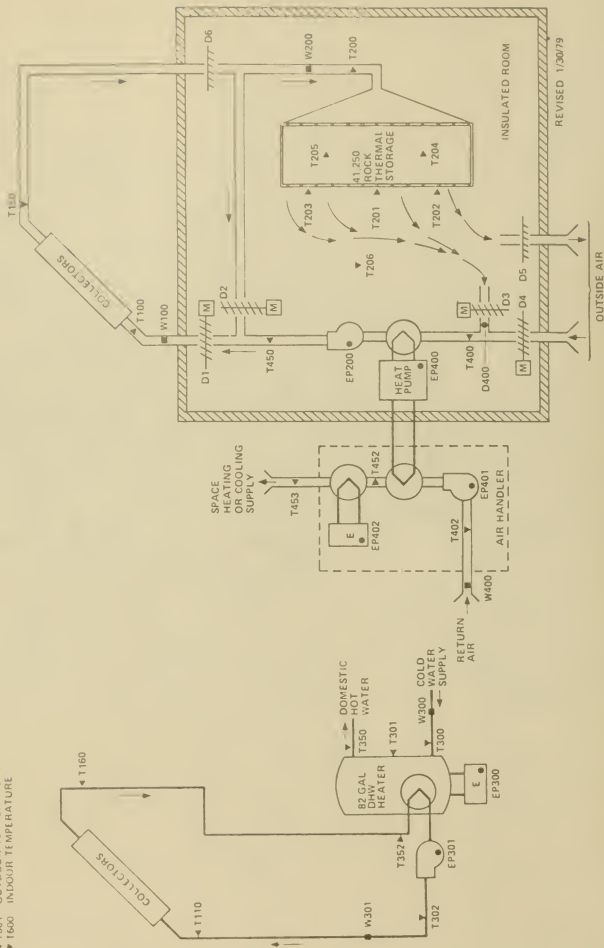- T001 OUTDOOR TEMPERATURE
- T600 INDOOR TEMPERATURE

Figure 1. ZEIN MECHANICAL SOLAR ENERGY SYSTEM SCHEMATIC

REVISED 1/30/79

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hot water is provided by a 4.5-kw electric element in the DHW heater. For freeze protection, the DHW heater contains an interior chamber large enough to accommodate the collector loop distilled water when the system is not operating. The DHW system activates the collector pump to collect solar energy when the differential temperature between the collector outlet and the bottom of the hot water tank is greater than 10 degrees. When solar energy is unavailable, the pump deactivates to permit automatic draining.

The Zein Mechanical No. 1 system has five modes of heating and five modes of cooling. A matrix of operating modes, damper positions and mode control temperature sensor conditions is shown in Table 1.

Mode 1 - Storage-to-Space Heating: This winter mode is entered when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is less than 10°F above the rock thermal temperature. Air is drawn through motorized dampers from storage using the collector/heat pump circulating fan, past the heat pump evaporator coil, bypassing the collector, and back to storage. The heat pump condensor coil and house circulating fan supply energy to the house. Strip heaters supplement the heat pump to meet the heating demand.

Mode 2 - Collector-to-Storage: This winter mode is entered when the collector outlet temperature is 10°F higher than a temperature representative of storage, and the outside ambient temperature is less than 10°F above the rock thermal storage temperature. Air is drawn from the collector using the collector/heat pump circulating fan into the rock thermal storage through motorized dampers and recirculated through the collector. There may or may not be a demand for space heating.

Mode 3 - Outside Air-to-Storage (Heating): This mode is entered when the collector loop is inactive, there is no demand for space heating, and the outside ambient temperature is greater than 10°F above the rock thermal storage temperature. Air is drawn from the outside using the collector/ heat pump circulating fan into the rock thermal storage through motorized dampers and then exhausted to the outside through a backdraft damper in the wall of the insulated room.

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TABLE 1

Heating and Cooling Operating Mode Matrix

WINTER HEATING OPERATING MODE

MODE	Tc-Tr $\geq$ 10°F	Ta-Tr $\geq$ 10°F	CALL FOR HEAT	FAN	DAMPER			
					D1	D2	D3	D4
OFF	NO	NO	NO	OFF	C	O	O	C
1	NO	NO	YES	ON	C	O	O	C
2	YES	NO	–	ON	O	C	O	C
3	NO	YES	NO	ON	C	O	C	O
4	NO	YES	YES	ON	C	O	C	O
5	YES	YES	–	ON	O	C	C	O

SUMMER COOLING OPERATING MODE

MODE	Tc-Tr $\leq$ -10°F	Ta-Tr $\leq$ -10°F	CALL FOR COOLING	FAN	DAMPER			
					D1	D2	D3	D4
OFF	NO	NO	NO	OFF	C	O	O	C
6	NO	NO	YES	ON	C	O	O	C
7	YES	NO	–	ON	O	C	O	C
8	NO	YES	NO	ON	C	O	C	O
9	NO	YES	YES	ON	C	O	C	O
10	YES	YES	–	ON	O	C	C	O

MODE CONTROL TEMPERATURE SENSORS:

Tc - TEMPERATURE OF COLLECTORS

Ta - TEMPERATURE OF OUTSIDE AMBIENT AIR

Tr - TEMPERATURE OF ROCK STORAGE

Mode 4 - Outside Air-to-Space Heating: This winter mode is entered when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is greater than 10°F above the rock thermal storage temperature. Air is drawn from the outside through motorized dampers past the heat pump evaporator coil, through the rock thermal storage, and then exhausted to the outside through a backdraft damper in the wall of the insulated room. The heat pump condenser coil and house circulating fan supply energy to the house. Strip heaters supplement the heat pump to meet the heating demand.

Mode 5 - Outside Air-to-Collector (Heating): This mode is entered when the difference in temperature between the collector outlet temperature is 10°F higher than a temperature representative of storage, and the outside ambient temperature is greater than 10°F above the rock thermal storage temperature. Air is drawn from outside using the collector/heat pump circulating fan, through the collector, into the rock thermal storage through motorized dampers and then exhausted to the outside. There may or may not be a demand for space heating.

Mode 6 - Storage-to-Space Cooling: This summer mode is entered when there is a demand for space cooling, the collector loop is not active, and the storage temperature is less than 10°F above the outside ambient temperature. Air is drawn through motorized dampers from storage using the collector/heat pump fan, past the heat pump condenser coil, by-passing the collector, and back to storage. The heat pump evaporator coil and house circulating fan remove energy from the house.

Mode 7 - Collector Heat Rejection: This mode rejects storage energy by circulating air through the collectors at night. This summer mode is entered when the temperature of the storage is more than 10°F higher than the collector outlet temperature, and the storage temperature is less than 10°F above the outside ambient temperature. Air is drawn from the

collector at night using the collector/heat pump circulating fan into
storage, through motorized dampers, and recirculated through the collector.
There may or may not be a demand for space cooling.

Mode 8 - Storage Heat Rejection: This mode is entered when the collector
loop is inactive, there is no demand for space cooling, and the rock
thermal storage temperature is greater than 10°F above the outside
ambient temperature. Air is drawn from the outside using the collector/
heat pump circulating fan into the rock thermal storage, through motorized
dampers, and then exhausted to the outside through a backdraft damper in
the wall of the insulated room.

Mode 9 - Outside Air-to-Space Cooling: This summer mode is entered when
there is a demand for space cooling, the coolector loop is not active, and
the rock thermal storage temperature is greater than 10°F above the outside
ambient temperature. Air is drawn from the outside through motorized
dampers to the heat pump, past the heat pump condenser coil, through the
rock thermal storage, and then exhausted to the outside through a back-
draft damper in the wall of the insulated room. The heat pump evaporator
coil and house circulating fan remove energy from the house to meet the
cooling load.

Mode 10 - Outside Air-to-Collector (Cooling): This mode is entered when
the temperature of the rock thermal storage is 10°F lower than the col-
lector outlet temperature, and the rock thermal storage temperature is
greater than 10°F above the outside ambient temperature. Air is drawn
from outside through the collector using the collector/heat pump circulat-
ing fan, into the rock thermal storage, through motorized dampers, and
then exhausted to the outside. There may or may not be a demand for space
cooling.

II. PERFORMANCE EVALUATION

A. Introduction

The system performance evaluations discussed in this section are based
primarily on the analysis of the data presented in the attached computer-
generated monthly report. This attached report consists of daily site
thermal and energy values for each subsystem, plus environmental data. The
performance factors discussed in this report are based upon the definitions
contained in NBSIR-76-1137, Thermal Data Requirements and Performance Eval-
uation Procedures for the National Solar Heating and Cooling Demonstration
Program.

The Zein Mechanical site is an unoccupied model home. Because it is un-
occupied, the house had a low space heating, space cooling, and hot water
demand. The Zein Mechanical site operated only in the auxiliary cooling
modes for space conditioning during June.

No space heating demand occurred during the month. The dwelling was con-
verted to the cooling modes.

The water solar energy system satisfied 34 percent of the DHW demand of
0.04 million Btu with a resultant savings of 0.33 million Btu (95 kwh)
of electrical energy.

The space cooling system was operated in the summer cooling Modes 6 and 9,
which uses the heat pump in the cooling modes. The space cooling system
satisfied the space cooling demand of 0.30 million Btu using the heat pump
auxiliary. The heat pump coefficient of performance was 1.96, which is
considerably less than the predicted performance of 2.5 for the heat pump
in the cooling mode.

Although not part of the solar energy system, the space cooling system perfor-
mance is indicated in the Extra Load Subsystem Report. Also, the heat pump
space cooling performance is shown in the Auxiliary Thermodynamic Conversion

Equipment Report. Refer to attached computer-generated printout for this cooling data.

B.   Weather

The cloud cover in June was above normal, as indicated by comparing the measured insolation with the predicted long-term monthly insolation. The insolation available on the solar energy system collector arrays during the month averaged 1,449 Btu/ft^2-day, which is below the 1,599 Btu/ft^2-day expected for the month. This is computed using an algorithm to estimate the insolation on a tilted surface from the long-term insolation data (on a horizontal surface) derived from measurements taken at the airport in Milwaukee, Wisconsin.

The measured ambient temperature was 66°F, which is 2°F higher than the 64°F predicted for June.

C.   Space Heating System Thermal Performance

Collector - The collection system was inoperative during the month because of the lack of a space heating and/or rock bed energy rejection requirement.

Storage - No solar energy was collected or delivered to storage. However, operation of the space heating system actually provided 0.49 million Btu of evaporator cooling energy to the rock thermal storage. A total of 0.002 million Btu was extracted from storage and utilized to preheat the air to the heat pump. The storage thermal loss was 0.31 million Btu.

Space Heating Load - During June, the space heating load was expected to be low. The space heating load was below normal because the average monthly temperature of 66°F was above the 64°F long-term averages for the month of June. There were 76 heating degree-days measured at the site, compared with the 90 heating degree-days predicted from long-term averages. No space heating demand occurred during the month because the dwelling was in the cooling mode.

D. Domestic Hot Water Thermal Performance

Collector - Of the 3.37 million Btu of solar energy incident on the collector array during June, 0.85 million Btu were incident on the array when the collector circulating pump was operating. The system collected 0.47 million Btu or 14 percent of the total insolation incident on the collector array. The operation of the collector circulating pump required 0.04 million Btu of electrical energy.

Storage - Of the 0.85 million Btu of solar energy collected, 0.37 million Btu were delivered to storage. A total of 0.04 million Btu were extracted from storage and delivered to the domestic hot water demand. The storage thermal loss was 0.79 million Btu. The high loss is due to the low consumption of hot water because the model home is unoccupied. Thermal loss from the transport system between the collector array and storage amounted to 0.48 million Btu, or 56 percent of the collected energy.

Domestic Hot Water Load - An average of five gallons of hot water was used each day and delivered at an average temperature of 137°F. The hot water was replaced with cold water at an average temperature of 62°F, which resulted in a hot water load of 0.04 million Btu. In order to satisfy this load and maintain domestic hot water average temperature at 137°F, 0.83 million Btu were supplied to the DHW heater. Of the 0.83 million Btu supplied to the DHW heater, 0.37 million Btu were supplied by solar energy, and 0.46 million Btu were supplied by auxiliary electrical energy resulting in a solar contribution to the load of 34 percent.

E. Space Cooling System

The space cooling demand was 0.30 million Btu, which was provided entirely by the heat pump. The space cooling load was high for the month of June because the cooling degree-day was 128 as compared to the long-term predicted cooling degree-day of 75. The coefficient of performance of the heat pump in the cooling mode was 1.96 as compared to a predicted coefficient of 2.5 for this heat pump operating under the measured weather conditions.

F.   Observations

The poor heat pump performance is probably due partially to the measure-
ment inaccuracies of the air flow sensors at the site. The elimination
of known duct leaks is necessary to obtain an accurate energy balance for
the system. To identify the duct leaks, a duct flow survey would have to
be completed at the inlet and outlet of each major subsystem and at the
sensor locations.

G.   Energy Savings

The Zein Mechanical solar energy system for space heating was inoperative
during the month of June. Thus, no savings were accrued.

The Zein Mechanical Domestic Hot Water savings were 0.33 million Btu. The
energy savings are based on the energy requirements of a conventional
domestic hot water tank compared to the energy requirements of the solar
energy system. The energy conversion efficiency from electrical to thermal
energy was assumed to be 100 percent.

III. ACTION STATUS

Minor instrumentation problems exist at the site. Site rework activity is
necessary to survey air ducts to determine an accurate energy balance for
the space heating system. Some temperature probes should be replaced.

A large air flow leak has been detected in the plenum system of the space
heating collectors. The air leaks must be isolated and sealed in order
for the system to perform to design specifications.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ZEIN MECHANICAL-I
REPORT PERIOD: JUNE, 1978

SITE/SYSTEM DESCRIPTION:
THE ZEIN MECHANICAL-I SOLAR ENERGY SYSTEM UTILIZES A SOLAR ASSISTED HEAT PUMP TO PROVIDE HEATING AND COOLING OF A SINGLE FAMILY DWELLING. THE COLLECTION SUBSYSTEM CONSISTS OF 384 SQ FT OF SOLAR COLLECTORS. ENERGY ... DURING ... THE HEAT PUMP. COOLING ENERGY IS SUPPLIED BY THE HEAT PUMP AND SUPPLIED STORAGE. 4 KW AND 6 KW ELECTRIC STRIP HEATER. HEAT PUMP WHICH CONTAINS BOTH A

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	16.695	MILLION BTU
	43479	BTU/SQ.FT.
	0.000	MILLION BTU
COLLECTED SOLAR ENERGY		
AVERAGE AMBIENT TEMPERATURE	66	DEGREES F
AVERAGE BUILDING TEMPERATURE	73	DEGREES F
... CONVERSION EFFICIENCY	-0.00	
...SOLAR...ENERGY	0.000	MILLION BTU
...OPERATING ENERGY	0.000	MILLION BTU
TOTAL ENERGY CONSUMED	0.000	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	N.A.	0.000	N.A.	0.000	MILLION BTU
SOLAR FRACTION	N.A.	0.000	N.A.	0.000	PERCENT
...ENERGY USED	N.A.	0.0000	N.A.	0.000	MILLION BTU
OPERATING ENERGY	N.A.	0.0000	N.A.	0.000	MILLION BTU
AUX...THERMAL...	N.A.	0.000	N.A.	0.000	MILLION BTU
AUX...ELECTRICAL	N.A.	0.000	N.A.	0.000	MILLION BTU
...FOSSIL FUEL	N.A.	0.000	N.A.	0.000	MILLION BTU
ELECTRICAL SAVINGS	N.A.	0.000	N.A.	0.000	MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A.	MILLION BTU

SYSTEM PERFORMANCE FACTOR: 1.44

* DENOTES UNAVAILABLE DATA
N.A. DENOTES NOT APPLICABLE DATA

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SOLAR/1057-78/06

SITE: ZEIN MECHANICAL-I
REPORT PERIOD: JUNE,1978

SITE/SYSTEM DESCRIPTION:
THE ZEIN MECHANICAL-I SOLAR ENERGY SYSTEM UTILIZES A SOLAR ASSISTED
HEAT PUMP TO HEAT AND COOL A 139 SQ.FT SINGLE-FAMILY DWELLING. THE
COLLECTION SUBSYSTEM CONSISTS OF 384 SQ.FT OF AIR COLLECTORS TIED TO AT
SOLAR ENERGY. DURING THE DAY THE WIND DURING IS SUBJECT HEAT PUMP
COOLING. ENERGY OPERATING SYSTEM. THE ENERGY USED IS COLLECTOR STORAGE
AUXILIARY HEATING SUPPLIED - THE HEAT PUMP WHICH CONTAINS BOTH A
4 KW AND 6 KW ELECTRIC STRIP HEATER.

GENERAL SITE DATA:
INCIDENT SOLAR ENERGY   17.614   GIGA JOULES
                                   49374.8 KJ/SQ.M.
                                   0.000   GIGA JOULES

COLLECTED SOLAR ENERGY

AVERAGE AMBIENT TEMPERATURE   13   DEGREES C
AVERAGE BUILDING TEMPERATURE   23   DEGREES C
SOLAR CONVERSION EFFICIENCY   -0.00 KJ/SQ.M.
ECSS. OPERATING ENERGY   0.000 GIGA JOULES
TOTAL ENERGY CONSUMED   0.000 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	N.A.	0.000	N.A.	0.000	GIGA JOULES
SOLAR FRACTION	N.A.	0.000	N.A.	0.000	PERCENT
SOLAR ENERGY USED	N.A.	0.0000	N.A.	0.0000	GIGA JOULES
OPERATING ENERGY	N.A.	0.0000	N.A.	0.0000	GIGA JOULES
AUX. THERMAL ENERGY	N.A.	0.0000	N.A.	0.0000	GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	0.0000	N.A.	0.0000	GIGA JOULES
AUX. FOSSIL FUELS	N.A.	0.00	N.A.	0.00	GIGA JOULES
ELECTRICAL SAVINGS	N.A.	0.N.A.	N.A.	N.A.	GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A.	GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 1.44

* DENOTES UNAVAILABLE DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
           OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
           SOLAR/0004-78/18

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: ZEIN MECHANICAL-I
REPORT PERIOD: JUNE, 1978

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING MILLION BTU	ECSS REJECTED ENERGY MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	1.659	66	0.000	NOT APPLICABLE	0.000	0.000	0.000
2	1.764	61	0.000		0.000	0.000	0.000
3	1.642	59	0.000		0.000	0.000	0.000
4	0.972	55	0.000		0.000	0.069	0.000
5	1.522	60	0.000		0.000	0.317	0.000
6	1.630	67	0.000		0.000	0.000	0.000
7	1.709	65	0.000		0.000	0.000	0.000
8	0.964	55	0.000		0.000	0.000	0.000
9	1.584	53	0.000		0.000	0.000	0.000
10	1.640	58	0.000		0.000	0.000	0.000
11	1.409	60	0.000		0.000	0.000	0.000
12	1.283	62	0.000		0.000	0.000	0.000
13	1.448	55	0.000		0.000	0.000	0.000
14	*	53	*		*	*	*
15	0.749	56	0.000		0.000	0.000	0.000
16	1.269	67	0.000		0.000	0.000	0.000
17	1.589	69	0.000		0.000	0.000	0.000
18	1.185	69	0.000		0.000	0.000	0.000
19	1.528	63	0.000		0.000	0.000	0.000
20	1.592	67	0.000		0.000	0.000	0.000
21	0.627	59	0.000		0.000	0.000	0.000
22	0.161	69	0.000		0.000	0.000	0.000
23		69					
24		80					
25		78					
26		79					
27		71					
SUM	16.695		0.000	N.A.	0.000	0.711	-0.100
AVG	0.556	66	0.000	N.A.	0.000	0.023	-0.001
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SITE: ZEIN MECHANICAL—T
REPORT PERIOD: JUNE,1978

DAY OF MONTH	INCIDENT ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	.659	0.000	0.000	*	0.000
2	.765	0.000	0.000	66	0.000
3	.474	0.000	0.000	75	0.000
4	.698	0.000	0.000	64	0.000
5	.762	0.000	0.000	82	0.000
6	.571	0.000	0.000	79	0.000
7	.710	0.000	0.000	*	0.000
8	.709	0.000	0.000	*	0.000
9	.660	0.000	0.000	*	0.000
10	.758	0.000	0.000	*	0.000
11	.164	0.000	0.000	64	0.000
12	.621	0.000	0.000	59	0.000
13	.340	0.000	0.000	55	0.000
14	.289 *	0.000	0.000	71	0.000
15	.748	0.000	0.000	73	0.000
16	.267	0.000	0.000	76	0.000
17	.759	0.000	0.000	*	0.000
18	.585	0.000	0.000	69	0.000
19	.086	0.000	0.000	*	0.000
20	.276	0.000	0.000	*	0.000
21	.590	0.000	0.000	*	0.000
22	.627	0.000	0.000	*	0.000
23	.540	0.000	0.000	85	0.000
24	.184	0.000	0.000	*	0.000
SUM	16.695	0.000	0.000		
AVG	0.556	0.000	0.000	71	0.000
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SITE: TEIN MECHANICAL-I
REPORT PERIOD: JUNE,1978

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.000	0.000	0.000	64	1.000
2	0.000	0.000	0.000	64	1.000
3	0.000	0.000	0.000	63	1.000
4	0.000	0.000	0.000	63	1.000
5	0.000	0.000	0.006	65	0.876
6	0.184	0.001	0.002	65	1.000
7	0.070	0.000	0.161	84	0.193
8	0.000	0.000	0.124	72	1.000
9	0.000	0.000	0.066	77	1.000
10	0.000	0.000	0.007	72	1.000
11	0.000	0.000	0.013	71	1.000
12	0.000	0.000	0.003	08	1.000
13	0.000	0.000	0.003	68	1.000
14	0.000	0.000	0.030	57	1.000
15	0.000	0.000	0.001	57	1.000
16	0.000	0.000	0.030	67	1.000
17	0.000	0.000	0.000	67	1.000
18	*	*	0.002	66	*
19	0.000	0.000	0.045	66	1.000
20	0.000	0.000	0.054	66	1.000
21	0.000	0.000	0.003	66	1.000
22	0.000	0.000	0.137	67	1.000
23	0.000	0.000		67	1.000
24	0.000	0.000		68	1.000
25	0.000	0.000		68	1.000
26	0.000	0.000		74	0.644
27	0.000	0.000			
28	0.000	0.000			
29	0.000	0.000			
30	0.213	0.000			
SUM	0.486	0.001	0.179		
AVG	0.016	0.000	0.005	69	0.373
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SOLAR/1057-78/06

SITE: ZEIN MECHANICAL-I
REPORT PERIOD: JUNE, 1978

DAY-MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FRAC LOAD PCT	SOLAR ENERGY MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUXIL FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	ENERGY FOSSIL SAVINGS MILLION BTU	BLDG TEMP DEG. F	AVG TEMP DEG.
	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113
1	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	71	66
2	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	72	61
3	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	68	59
4	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	68	65
5	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	65	60
6	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	69	72
7	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	69	75
8	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	67	64
9	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	71	59
10	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	71	53
11	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	69	58
12	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	67	62
13	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	73	63
14	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	74	68
15	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	73	67
16	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	73	70
17	*	*	*	*	*	*	*	*	*	*	*
18	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	75	69
19	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	76	63
20	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	73	67
21	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	74	65
22	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	77	68
23	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	70	69
24	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	81	69
25	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.	75	80
26	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.		78
27	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.		79
28	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.		71
29	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.		
30	0.00	0	0.00	0.00	0.00	0.00	N.A.	0.00	N.A.		
SUM	0.00		0.00	0.00	0.00	0.00	N.A.	0.00	N.A.		
AVG		0								73	66
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SOLAR/1057-78/06

SITE: ZEIN MECHANICAL-I
REPORT PERIOD: JUNE, 1978

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1785	N	66	**	N	N	N
2	1023	O	61	66	O	O	O
3	1586	T	55	75	T	T	T
4	1818		60	64			
5	1980	A	60	82	A	A	A
6	1850	P	72	79	P	P	P
7	1497	P	55	**	P	P	P
8	1729	L	53	**	L	L	L
9	1709	I	68	**	I	I	I
10	1849	C	62	**	C	C	C
11	1709	A	55	64	A	A	A
12	1976	B	53	59	B	B	B
13	1429	L	63	75	L	L	L
14	1889	E	68	71	E	E	E
15	1755*		67	73			
16	1950		70*	76*			
17	1698		69	69			
18	1577		69	**			
19	1535		63	**			
20	1483		67	**			
21	1377		69	**			
22	1538		60	**			
23	1719		80	85*			
24	1603		80	**			
25	1680		79	**			
26	1480		71	**			
SUM	43479	N.A.			N.A.	N.A.	N.A.
AVG	1449	N.A.	66	71	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

THERMODYNAMIC MONTHLY REPORT
THERMODYNAMIC CONVERSION EQUIPMENT

SOLAR/1057-78/06
REPORT DATE: 15 MARCH 1979

SITE: ZEIN MECHANICAL-I
REPORT PERIOD: JUNE,1978

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	0.000	0.000	0.000		0.000
2	0.000	0.000	0.000		0.000
3	0.000	0.000	0.000		0.000
4	0.000	0.000	0.000		0.000
5	0.000	0.000	0.000		0.000
6	0.000	0.000	0.000		0.000
7	0.000	0.000	0.000		0.000
8	0.000	0.000	0.000		0.000
9	0.000	0.000	0.000		0.000
10	0.000	0.000	0.000		0.000
11	0.000	0.000	0.000		0.000
12	0.000	0.000	0.000		0.000
13	0.000	0.000	0.000		0.000
14	0.000	0.000	0.000		0.000
15	0.000	0.000	0.000		0.000
16	0.000	0.000	0.000		0.000
17	0.000	0.000	0.000		0.000
18	0.000	0.000	0.000		0.000
19	*0.000	*0.000	*0.000		*0.000
20	0.000	0.000	0.000		0.000
21	0.000	0.000	0.000		0.000
22	0.000	0.000	0.000		0.000
23	0.000	0.000	0.000		0.000
24	0.000	0.000	0.000		0.000
25	0.000	0.000	0.000		0.000
26	0.000	0.000	0.000		0.000
27	0.000	0.000	0.000		0.000
28	0.000	0.000	0.000		0.000
29	0.000	0.000	0.000		0.000
30	0.000	0.000	0.000		0.000
SUM	0.000	0.000	0.000	*	
AVG	0.000	0.000	0.000	*	0.000

NOTE: ENERGY REJECTED — NOT APPLICABLE

* DENOTES UNAVAILABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
MONTHLY REPORT
EXTRA LOAD SUBSYSTEM

SITE: ZETA MECHANICAL -- IN
REPORT PERIOD: JUNE 1978

DAY OF MONTH	LCAD MILLION BTU	FRACTION OF LOAD OF LCAD PERCENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUXL THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUXL FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU
1	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
2	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
3	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
4	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
5	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
6	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
7	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
8	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
9	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
10	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
11	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
12	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
13	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
14	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
15	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
16	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
17	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
18	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
19	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
20	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
21	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
22	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
23	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
24	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
25	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
26	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
27	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
28	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
29	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
30	0.000	NON	NON	0.000	0.000	0.000	N.A.	N.A.	N.A.
SUM	0.104	N.A.	N.A.	0.066	0.155	0.222	N.A.	N.A.	N.A.
AVG	0.010	N.A.	N.A.	0.002	0.005	0.007	N.A.	N.A.	N.A.

* N.A. DENOTES DATA UNAVAILABLE
NON DENOTES NOT APPLICABLE CATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
AUXILIARY THERMODYNAMIC CONVERSION EQUIPMENT

SITE: ZEIN MECHANICAL-1
REPORT PERIOD: JUNE, 1978

SOLAR/1057-78/06

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	0.000	0.000	0.000		0.000
2	0.000	0.000	0.000		0.000
3	0.000	0.000	0.000		0.000
4	0.000	0.000	0.000		0.000
5	0.000	0.000	0.000		0.302
6	0.105	0.065	0.010		2.304
7	0.086	0.070	0.010	N	1.754
8	0.000	0.000	0.000	O	0.000
9	0.000	0.000	0.000	T	0.000
10	0.000	0.000	0.000		0.000
11	0.000	0.000	0.000	A	0.000
12	0.000	0.000	0.000	P	0.000
13	0.000	0.000	0.000	P	0.000
14	0.000	0.000	0.000	L	0.000
15	0.000	0.000	0.000	I	0.000
16	0.000	0.000	0.000	C	0.000
17	0.000	0.000	0.020	A	0.000
18	0.000	0.000	0.000	B	0.000
19	0.000	0.000	0.000	L	0.000
20	*	*	*	E	*
21	0.000	0.000	0.000		0.000
22	0.000	0.000	0.000		0.000
23	0.000	0.000	0.000		0.000
24	0.000	0.000	0.000		0.000
25	0.000	0.000	0.000		0.000
26	0.000	0.000	0.003		0.000
27	0.000	0.000	0.000		0.000
28	0.000	0.000	0.000		0.000
29	0.000	0.078	0.012		0.000
30	0.101	0.078	0.012		1.851
SUM	0.304	0.222	0.035	*	
AVG	0.010	0.007	0.001	N.A.	1.957

* DENOTES UNAVAILABLE DATA.
NOTE:

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SOLAR/1057 -78/06

SITE: TWIN MECHANICAL-II
REPORT PERIOD: JUNE,1978

SITE/SYSTEM DESCRIPTION:
THE ZETA MECHANICAL-II SOLAR ENERGY SYSTEM HEATS DOMESTIC HOT WATER THROUGH
THE USE OF 730 SQ. FT. OF LIQUID COLLECTORS AND AN 82 GALLON PREHEAT
TANK. THE HOT WATER AUXILIARY IS A 4.5 KW ELECTRIC ELEMENT IN THE DHW
TANK.

GENERAL SITE DATA:
INCIDENT SOLAR ENERGY   3.373   MILLION BTU
                                         4349   BTU/SQ.FT.
COLLECTED SOLAR ENERGY   0.771   MILLION BTU
                                         607   BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE   66   DEGREES
AVERAGE BUILDING TEMPERATURE   N.A.   DEGREES
COLLECTOR CONVERSION EFFICIENCY   0.1
ECSS SYSTEM OPERATING ENERGY   00.040 MILLION BTU
ECSS COP   0.090   MILLION BTU
TOTAL ENERGY CONSUMED   00.974 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.039	N.A.	N.A.	0.039 MILLION BTU
SOLAR FRACTION	34	N.A.	N.A.	34 PERCENT
SOLAR ENERGY USED	0.365	N.A.	N.A.	00.365 MILLION BTU
OPERATING ENERGY	N.A.	N.A.	N.A.	00.040 MILLION BTU
AUX. THERMAL ENERGY	0.462	N.A.	N.A.	00.462 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	0.462 MILLION BTU
ELECTRICAL SAVINGS	0.365	N.A.	N.A.	0.325 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.02

* DENOTES UNAVAILABLE DATA
N.A. DENOTES NOT APPLICABLE DATA

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SOLAR/1057 -78/06

SITE: ZEIN MECHANICAL-II
REPORT PERIOD: JUNE, 1978

SITE/SYSTEM DESCRIPTION:
THE ZEIN MECHANICAL-II SOLAR ENERGY SYSTEM HEATS DOMESTIC HOT WATER THROUGH
THE USE OF 77. SQ FT OF LIQUID COLLECTORS AND AN 82 GALLON PREHEAT
TANK. THE HOT WATER AUXILIARY IS A 4.5 KW ELECTRIC ELEMENT IN THE DHW
TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	3.559	GIGA JOULES
	49374.8	KJ/SQ.M.
COLLECTED SOLAR ENERGY	0.497	GIGA JOULES
	6899.1	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	19	DEGREES C
AVERAGE BUILDING TEMPERATURE	N.A.	DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	.11	
ECSS OPERATING ENERGY	0.042	GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.042	GIGA JOULES
TOTAL ENERGY CONSUMED	1.07	GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	0.041	N.A.	N.A.	0.041	GIGA JOULES
SOLAR FRACTION	34	N.A.	N.A.	34	PERCENT
SOLAR ENERGY USED	0.385	N.A.	N.A.	0.385	GIGA JOULES
OPERATING ENERGY	N.A.	N.A.	N.A.	0.042	GIGA JOULES
AUX. THERMAL ENERGY	0.487	N.A.	N.A.	0.487	GIGA JOULES
AUX. ELECTRIC FUEL	0.487	N.A.	N.A.	0.487	GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A.	GIGA JOULES
ELECTRICAL SAVINGS	0.385	N.A.	N.A.	0.343	GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A.	GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.02

* DENOTES UNAVAILABLE DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT

ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: ZEIN MECHANICAL-II
REPORT PERIOD: JUNE 1978

SOLAR/1057-78/06

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1		66					
2		61					
3		65					
4		60					
5		67					
6		72					
7		55					
8		53					
9		68					
10		62					
11		66					
12		67					
13		*					
14		69					
15		69					
16		63					
17		67					
18		58					
19		69					
20		80					
21		78					
22		71					
23							
24							
25							
26							
27							
28							
29							
30							
SUM	3.373		0.365	0.462	0.040	N.A.	
AVG	0.112	66	0.012	0.015	0.001	N.A.	0.108
NPS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: ZEIN MECHANICAL-II
REPORT PERIOD: JUNE 1978

SOLAR/1057 - 78/06

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	1.33	0.025	0.037	*	0.279
2	1.54	0.026	0.024	66	0.160
3	1.45	0.014	0.008	65	0.092
4	1.41	0.029	0.015	64	0.208
5	1.45	0.012	0.008	82	0.056
6	1.34	0.013	0.006	7	0.045
7	1.47	0.015	0.002	*	0.151
8	1.43	0.047	0.002	*	0.410
9	1.52	0.017	0.003	*	0.253
10	1.36	0.005	0.002	*	0.210
11	1.25	0.015	0.003	64	0.200
12	1.068	0.077	0.016	69	0.309
13	1.058	0.077	0.005	55	0.200
14	*	0.036	0.002	55	0.307
15	*	0.005	*	73	0.139
16	0.151	0.087	0.047	76	0.044
17	0.154	0.080	0.007	*	*
18	0.153	0.089	0.011	9	0.313
19	0.079	0.017	0.022	*	0.300
20	0.106	0.137	0.024	*	0.095
21	0.055	0.047	0.014	*	0.024
22	0.119	0.016	0.021	*	0.244
23	0.111	0.038	0.088	*	0.014
24	0.126	0.036	0.018	*	0.073
25	0.109	0.031	0.002	85	0.203
26	0.037	0.006	-0.002	*	0.088
27				*	0.068
28				*	0.173
29					-0.080
30					
SUM	3.373	0.850	0.471		
AVG	0.112	0.028	0.015	71	0.140
NBSID	Q001		Q100	71	N100

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SOLAR/1057 - 78/06

SITE: ZEIN MECHANICAL-II
REPORT PERIOD: JUNE, 1978

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.031	0.000	N	N	N
2	0.020	0.000	O	O	O
3	0.008	0.000	T	T	T
4	0.017	0.000			
5	0.007	0.000	A	A	A
6	0.007	0.000	P	P	P
7	0.029	0.000	P	P	P
8	0.100	0.000	L	L	L
9	0.007	0.000	I	I	I
10	0.034	0.000	C	C	C
11	0.020	0.000	A	A	A
12	0.002*	0.000	B	B	B
13	0.008	0.008	L	L	L
14	0.060	0.000	E	E	E
15	0.030	0.005			
16	0.048	0.000			
17	0.000	0.002			
18	0.009	0.000			
19	0.016	0.000			
20	0.015	0.000			
21	0.003	0.007			
22					
23					
24					
25					
26					
27					
28					
29					
30					
SUM	0.365	0.039	N.A.	N.A.	N.A.
AVG	0.012	0.001	*		
NBS ID	Q200	Q201	Q202	N.A.	N108

* DENOTES UNAVAILABLE DATA
N.A. DENOTES NOT APPLICABLE DATA.

SITE: ZEIN MECHANICAL-II
REPORT PERIOD: JUNE, 1978

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR. OF LOAD PER.	SOLAR ENERGY USED MILLION BTU	OPER. ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.000	0	0.010	N.A.	0.009	0.009	N.A.	0.010	N.A.	77	141	0
2	0.000	0	0.008	N.A.	0.008	0.008	N.A.	0.008	N.A.	77	141	0
3	0.000	0	0.007	N.A.	0.007	0.007	N.A.	0.007	N.A.	77	141	0
4	0.000	0	0.007	N.A.	0.007	0.007	N.A.	0.007	N.A.	77	141	0
5	0.000	0	0.007	N.A.	0.007	0.007	N.A.	0.007	N.A.	77	141	0
6	0.000	0	0.008	N.A.	0.008	0.008	N.A.	0.008	N.A.	77	141	0
7	0.000	0	0.008	N.A.	0.008	0.008	N.A.	0.008	N.A.	77	141	0
8	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	77	138	1
9	0.000	8	0.001	N.A.	0.004	0.004	N.A.	0.001	N.A.	65	141	1
10	0.000	4	0.001	N.A.	0.006	0.006	N.A.	0.001	N.A.	65	141	1
11	0.000	0	0.000	N.A.	0.002	0.002	N.A.	0.000	N.A.	65	141	0
12	0.000	0	0.001	N.A.	0.003	0.003	N.A.	0.001	N.A.	65	141	*
13	0.000	1	0.001	N.A.	0.002	0.002	N.A.	0.001	N.A.	65	130	5
14	0.000	3	0.000	N.A.	0.001	0.001	N.A.	0.000	N.A.	67	141	9
15	0.000	0	0.000	N.A.	0.001	0.001	N.A.	0.000	N.A.	65	141	3
16	0.000	0	0.003	N.A.	0.000	0.000	N.A.	0.003	N.A.	61	141	0
17	0.000	0	0.002	N.A.	0.000	0.000	N.A.	0.002	N.A.	51	140	0
18	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	55	140	0
19	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	55	141	0
20	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	55	141	0
21	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	55	141	0
22	0.000	0	0.001	N.A.	0.001	0.001	N.A.	0.001	N.A.	55	141	0
23	0.000	0	0.001	N.A.	0.001	0.001	N.A.	0.001	N.A.	55	141	0
24	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	55	141	0
25	0.000	0	0.001	N.A.	0.002	0.002	N.A.	0.001	N.A.	55	141	0
26	0.000	0	0.000	N.A.	0.001	0.001	N.A.	0.000	N.A.	57	141	0
27	0.000	0	0.003	N.A.	0.000	0.000	N.A.	0.003	N.A.	57	140	0
28	0.000	0	0.001	N.A.	0.000	0.000	N.A.	0.001	N.A.	57	141	0
29	0.000	0	0.003	N.A.	0.003	0.003	N.A.	0.003	N.A.	57	141	0
30	0.007	1	0.013	N.A.	0.013	0.013	N.A.	0.013	N.A.	56	136	2
SUM	0.039	34	0.365	N.A.	0.462	0.462	N.A.	0.365	N.A.	—	—	12
AVG	0.001	—	0.012	N.A.	0.015	0.015	N.A.	0.012	N.A.	62	137	58
NRS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
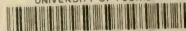
MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SOLAR/1057-78/06

SITE: ZEIN MECHANICAL-II
REPORT PERIOD: JUNE, 1978

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG. F	DAYTIME AMBIENT TEMP DEG. F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1718	N.A.	66	**	N.A.	N.A.	N.A.
2	1993		66	**			
3	1838		65	75			
4	1805		60	64			
5	1995		72	82			
6	1499		67	77			
7	1649		55	**			
8	1709		55	**			
9	1722		68	**			
10	1508		60	49			
11	1709		52	54			
12	1769		68	45			
13	1429		67	71			
14	1677		*	73			
15	1865		69	76			
16	1950		69	*			
17	1698		63	69			
18	1977		58	**			
19	1535		59	**			
20	1437		60	**			
21	1377		80	**			
22	1719		77	**			
23	1538		70	85			
24	1630		71	**			
25	1636						
26	1496						
27							
28							
29							
30							
SUM	43479	N.A.					
AVG	1449	N.A.	66	71	N.A.	N.A.	N.A.
N95 ID	Q001		NI13			NI15	NI14

* DENOTES UNAVAILABLE DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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